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ANNUAL REPORT — 1979

Project 10990061

A STUDY TO DEFINE THE MIGRATION CHARACTERISTICS OF CHINOOK AND COHO SALMON AND STEELHEAD IN THE COLUMBIA RIVER ESTUARY

by

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INTRODUCTION

The National Marine Fisheries Service (NMFS), in cooperation with the Pacific Northwest Regional Commission (PNRC), has completed a 3-year study of migrational characteristics of juvenile salmon and steelhead in the Columbia River estuary. The objectives of the study were to: 1) define migrational and behavioral characteristics of juvenile salmonids to the Columbia River estuary, 2) develop an estuarine sampling system to evaluate hatchery production techniques and procedures, and 3) define and monitor the survival of selected stocks of hatchery reared juvenile salmonids to the estuary and to examine the relationship of this survival to the number of adult fish returning to the hatchery and/or fishery.

In 1979, the third year of the study, beach seine and purse seine sampling was continued in the upper and lower estuary, and purse seine sampling was initiated in marine areas near the river mouth. This report summarizes the results of research activities conducted during 1979.

METHODS

Beach Seine Sampling

A variable-mesh seine 95 m long by 5 m deep of the type described by Sims and Johnsen (1974) was used to sample the juvenile migrations in the upper estuary at Jones Beach, Oregon at River Kilometer (RKm) 75 (Figure 1). Sampling at Jones Beach began in January 1979 and continued at various levels throughout the year (Table 1). Beach seine sampling began at sunrise each day and sets were made at 45 min intervals for about 7 h.

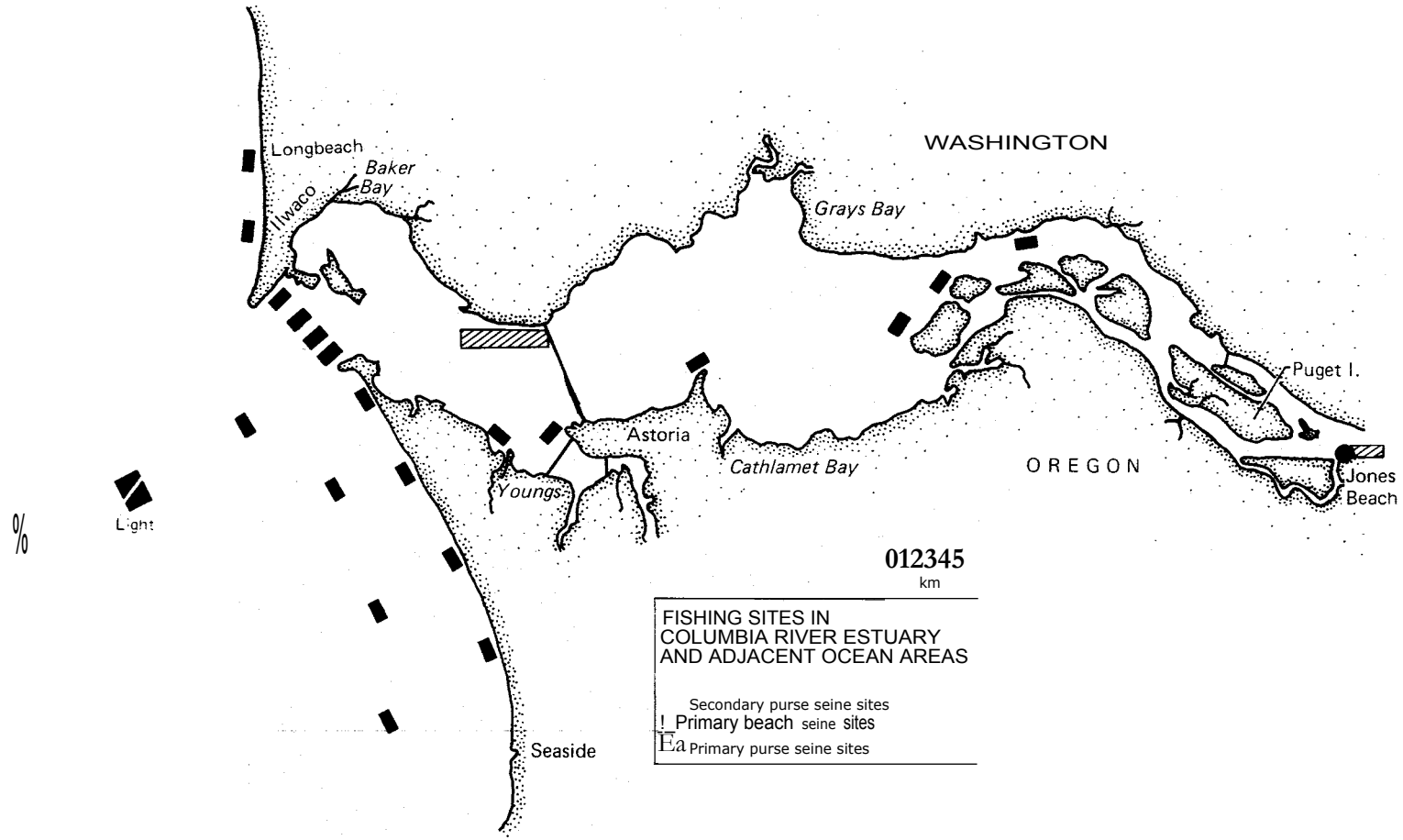

Figure L —The Oolunbia River estuary and Pacific °cean shouuing sarrnlinr* sites used in 1979.

Table 1.-Weekly beach seine catches at Jones Beach, Oregon (RKm 75), 1979.

Date (Mo./day)	No. of days fished	No. set	Chinook Subyearling Total catch (no.)	Chinook Subyearling Catch per set (no.)	Chinook Yearling Total catch (no.)	Chinook Yearling Catch per set (no.)	Coho Total catch (no.)	Coho Catch per set (no)	Steelhead Total catch (no.)	Steelhead Catch per set (no.)
1/01-1/14		0								
1/15-1/21	1	2	1	0	1			0		0
1/22-1/28	1	1	1	1	0	0	0	0	0	0
1/29-2/04	1	1	2	2	0	0	0	0	0	0
2/05-2/11	1	1	0	0	0	0	0	0	0	0
2/12-2/18	1	2'	6	3	6	3	0	0	0	0
2/19-2/25	0	0							0	0
2/26-3/04	1	2	4	2	9	4	0		0	0
3/05-3/11	1	2	6	3	4	2	0	0	0	0
3/12-3/18	3	9	65	7	30	3	0	0	0	0
3/19-3/25	3	9	138	15	22	4	0	0	0	0
3/26-4/01	6	23	2171	94	132	6	0	0	0	0
4/02-4/08	6	32	1072	34	237	7	1	0	0	0
4/09-4/15	6	36	972	27	477	13	144	4	0	0
4/16-4/22	6	51	1683	33	689	14	469	9	14	0
4/23-4/29	6	58	3875	67	654	11	731	13	24	0
4/30-5/06	7	58	7495	129	788	14.	593	10	44	1
5/07-5/13	6	52	9874	190	523	10	997	19	41	1
5/14-5/20	7	53	7479	141	155	3	608	11	24	0
5/21-5/27	7	61	6749	111	19	0	97	2	2	0
5/28-6/03	6	52	9357	180	27	0	111	2	3	0
6/04-6/10	7	60	17881	298	42	1.	73	1	4	0
6/11-6/17	7	63	5587	89	53	1	27	0	3	0
6/18-6/24	7	64	18262	285	42	1	11	0	4	0
6/25-7/01	6	57	19671	345	14	0	4	0	0	0
7/02-7/08	5	47	17034	362	8	0	3	0	0	0
7/09-7/15	6	57	11571	203	3	0	25	0	0	0
7/16-7/22	6	55	20217	366	0	0	11	0	0	0
7/23-7/29	6	54	18391	340	0	0	0	0	0	0
7/30-8/05	6	54	18447	342	0	0	0	0	0	0
8/06-8/12	6	55	13043	237	0	0	0	0	0	0
8/13-8/19	5	46	6008	131	0	0	0	0	1	0
8/20-8/26	5	46	5460	119	0	0	0	0	0	0
8/27-9/02	4	35	2894	83	0	0	0	0	0	0
9/03-9/09	4	35	2517	72	0	0	0	0	0	0
9/10-9/16	3	24	1802	75	0	0	0	0	0	0
9/17-9/23	1	3	224	75	0	0	0	0	0	0
9/24-9/30	1	3	106	35			0	0	0	0
10/01-12/31	0	0	-							
Totals		1263	230065		3935		3905		164	

Purse Seine Sampling

A 206-m long by 11-m deep purse seine was used to sample juvenile salmonids at Jones Beach. A 305-m long and 11-m deep purse seine was used in the lower estuary and in marine areas adjacent to the river mouth. The primary sampling site in the lower estuary was at RKm 16 (Figure 1). The sampling schedule was dependent on the availability of personnel and equipment (Tables 2-4). Fishing techniques used were as described by Johnsen and Sims (1973). Periodic purse seine sampling was also conducted at selected secondary sites within the estuary (Appendix Table 1).

Sample Processing

Beach seine and purse seine catches at Jones Beach were examined at permanent fish processing facilities on the beach. Fish taken at lower estuary sampling sites were processed on board the purse seine vessel.

All fish were anesthetized with MS-222 or benzocaine, enumerated by species, and examined for identifying marks. Juvenile chinook salmon were separated into subyearling and yearling categories on the basis of fork length. The separation point was determined from length frequency samples. There was a small amount of overlap in the size frequency distributions, but the method was, in general, satisfactory. Mark recaptures were recorded by species, length, sampling gear, sampling site, time, and date. After processing, all fish were placed in fresh water, allowed to recover from the effects of the anesthetic, transported out of the sampling area, and released back into the river.

Up to 100 salmonids with a clipped adipose fin were subsampled and sacrificed per day per specie for identification of coded wire tags (cwt.). Extrapolation of the subsample was made to determine the tag distribution of the entire adipose clip sample. Researchers from other agencies

Table 2.--Weekly purse seine catches at Jones Beach, Oregon (RKm 75), 1979.

Date (Mo./day)	No. of days fished	No. sets	Chinook Subyearling Total catch (no.)	Chinook Subyearling Catch per set (no.)	Chinook Yearling Total catch (n)	Chinook Yearling Catch per set (no)	Coho Total catch ~n)	Coho Catch per set (0)	Steelhead Total catch n)	Steelhead Catch per set (o)
1/01-1/14	0	0	-	-	-	-	-			
1/15-1/21	1	1	0	0	0	0	0	0		
1/22-1/28	1	1	0	0	0	0	0	0		
1/29-2/04	0	0	-	-	-	-	-	-		
2/05-2/11	1	1	0	0	0	0	0	0		0
2/12-2/18	1	1	0	0	0	0	0	0	0	
2/19-2/25	0	0	-	-	-	-	-	-		
2/26-3/04	1	1	0	0	0	0	0	0	0	
3/05-3/11	1	1	0	0	0	0	0	0	0	
3/12-3/18	3	3	0	0	2		0	0	0	
3/19-3/25	3	3	1	0	8	3	0	0	1	
3/26-4/01	3	5	151	30	11	2	0	0	0	
4/02-4/08	4	8	23	3	88	11	0	0	1	
4/09-4/15	4	11	0		351	32	16	1	14	
4/16-4/22	5	24	115	5	1138	47	117	5	277	
4/23-4/29	6	27	1253	46	2543	94	599	22	637	
4/30-5/06	7	31	397	13	2561	83	1538	50	1254	
5/07-5/13	6	26	619	24	1572	60	2353	91	2125	
5/14-5/20	7	29	3366	116	2705	93	4123	142	2455	
5/21-5/27	6	25	3451	138	1710	68	4131	165	1196	
5/28-6/03	6	28	2691	96	3392	121.	4913	175	1295	
6/04-6/10	7	29	1757	61	.1614	56	4280	148	540	
6/11-6/17	7	33	1663.	50	.660	'20	3311	100	275	
6/18-6/24	7	31	3232	104	378	12	841	27	181	
6/25-7/01	6	25	9121-	365	25	1	272	11	45	
7/02-7/08	3	15	3049	203	30	2	76	5	10	
7/09-7/15	4	19	1237	65	2	0	1005	53	4	
7/16-7/22	3	13	1243	96	0	0	93	7	1	
7/23-7/29	3	9	686	76	0	0	10	1	0	
7/30-8/05	3	9	1171	130	0	0	3	0	1	
8/06-8/12	3	9	544	60	2	0	2	0	❑	0
8/13-8/19	4	13	1950	150	0	0	1	0	2	0
8/20-8/26	2	5	283	57	0	0	0	0	❑	0
8/27-9/02	1	2	40	20	0	0	0	0	❑	0
9/03-9/09	1	2	41	20	0	0	0	0	❑	0
9/10-9/16	1	2	39	20	0	0	0	0	❑	0
9/17-9/23	1	1	18	18	0	0	0	0	❑	0
9/24-9/30	1	1	22	22	0	0	0		❑	0
10/1-12/31	0									
Totals		444	38163		18792		27684		10314	

Table .--Weekly purse seine catches at Columbia River.(RKn 16), 1979.

Date (Mo.,/day)	No. of days fished	No. set	Chinook				Coho		Steelhead	
			Subyearling		Yearling		(Juv.)		(Juv.)	
			Total catch (no.)	Catch per set (no.)	Total catch (no.)	Catch per set (no.)	Total catch (no.)	Catch per set (no.)	Total catch (no.)	Catch per set (no.)
1/01-4/22	0	0	0	-						
4/23-4/29	1	4	0	0	27	7	6	2	1	0
4/30-5/06	1	4	0	0	411	103	224	56	125	31
5/07-5/13	2	7	59	8	528	75	392	56	136	19
5/14-5/20	0	0	0	0	0	0	0	0	0	0
5/21-5/27	2	6	625	104	287	48	422	70	58	10
5/28-6/03	1	3	326	109	65	22	183	61	19	6
6/04-6/10	2	7	2309	330	73	10	114	16	13	2
6/11-6/17	3	9	1423	159	40	4	335	37	24	3
6/18-6/24	2	6	2 761	460	11	2	86	14	5	1
6/25-7/01	1	4	867	217	13	3	27	7	3	1
7/02-7/08	2	8	1306	163	2	0	7	1	0	0
7/09-7/15	2	8	837	105	0	0	37	5	0	0
7/16-7/22	4	15	1047	70	0	0	20	1	0	0
7/23-7/29	0	0	0	0	0	0	0	0	0	0
7/30-8/05	2	8	404	50	0	0	0	0	0	0
8/06-8/12	2	8	96	12	0	0	0	0	0	0
8/13-8/19	2	6	270	45	4	1	0	0	0	0
8/20-8/26	2	8	377	47	0	0	0	0	0	0
8/27-9/02	3	14	**936**	67	1	0	1	0	0	0
9/03-9/09	2	9	376	42	3	0	0	0	0	0
9/10-9/16	3	17	1888	111	0	0	0	0	0	0
9/17-9/23	2	11	712	65		0	0	0	0	0
9/24-12/31		0								
Totals		162	16619	-	1465		1854		384	

Table 4.--Weekly purse seine catches in marine waters adjacent to 'Columbia River mouth (within 24 km), 1979.

Date (Mo./day)	No. of days fished	No. set	Chinook Subyearling Total catch (no.)	Chinook Subyearling Catch per set (no.)	Chinook Yearling Total catch (no.)	Chinook Yearling Catch per set (no.)	Coho (Juv.) Total catch (na.)	Coho (Juv.) Catch per set (no.)	Steelhead (Juv.) Total catch (no.)	Steelhead (Juv.) Catch per set (no.)
1/01-5/06										
5/07-5/13		4		1	19					0
5/14-5/20		4	9	2	20	5	1	0	0	0
5/21-5/27		4	14	3	6	1	8	2	0	0
5/28-6/03			0	0	0	0	0	0	0	0
6/04-6/10		3	25	8	7	2	3	1	0	0
6/11-6/17		0	0	0	0	0	0	0	0	0
6/18-6/24	1	4	13	3	16	4	0	0	0	0
6/25-7/01	1	2	731	365	15	7	0	0	0	0
7/02-7/08	2	9	286	32	20	2	17	2	0	0
7/09-7/15	1	5	0	0	13	3	16	3	0	0
7/16-7/22	1	5	0	0	3	1	14	3	0	0
7/23-7/29	0	0	0	0	0	'0	0	0	0	0
7/30-8/05	2	10	13	1	0	0	3	0	0	0
8/06-8/12	2	10	257	26	10	1	0	0		0
8/13-8/19	2	10	91	9	0	0	0	0	0	0
8/20-8/26	2	9	74	8	1	0	2	0	0	0
8/27-9/02	2	10	105	11	16	2	1	0	0	0
9/03-9/09	1	5	3	1	4	1	7	1	0	0
9/10-9/16	1	5	17	3	0	0	0	0	0	0
9/17-9/23	2	10	88	9			0		0	0
9/24-12/31	0	0								
Total		109	1730	150	150	-	74		0	

investigating different aspects of smolt behavior were provided with biological samples taken from the sacrificed fish with cwt. Gill tissue samples were provided to NMFS researchers for adenosine triphosphatase (Na^+-K+ ATPase) analysisl/. Scale samples were provided to Oregon Department of Fish and Wildlife (ODFW) researchers for analysis of timing and survival from the Deschutes, John Day, and Willamette River basins?/. Stomach samples were provided to U.S. Fish and Wildlife Service (USFWS) researchers3/ and to members of our own staff for analysis of stomach contents.

Diel Sampling

Purse seine sampling was conducted during the peak of outmigration in mid-river at Jones Beach on 10 and 23 May to examine diel catch patterns of juvenile salmonids. Seining was begun at sunrise and sets were continued every 1-1/2 h for a 24-h period. Data from both sampling periods were averaged to present results.

Analysis of Marked Fish Recaptures

Marked hatchery fish were released at many locations throughout the Columbia River system in 1979 (Figure 2). Recaptures from these marked

1/ Earlprentice, Project Leader, NMFS, Manchester, WA 98353

2/ Eugene (Max) Smith, Project Leader, ODFW, Springfield, OR 97477; Richard Aho, Project Leader,.ODFW, Maupin, OR 97037

3/ Percy Washington, Project Leader, Northwest Fishery Research Center, USFWS, Sandpoint Naval Air Station, Seattle, WA 98115

Figure 2.--Release locations of marked juvenile salmonids recaptured in Columbia River estuary 1979.

LEGEND

1. Klaskanise Hatchery
2. Columbia R. @ Hammond
3. Stavebolt Creek
4. Grays R. Hatchery
5. Elokomin Hatchery
6. Big Creek Hatchery
7. Abernathy Research Station
8. Columbia River @ Jones Beach
9. Cowlitz Trout Hatchery
10. Cowlitz Salmon Hatchery
11. Toutle River Hatchery
12. Columbia River @ Prescott
13. Kalama Falls Hatchery
14. Lewis River Hatchery
15. Willamette River, falls area
16. Mollalla River
17. Tualatin River
18. N. F. Santiam - Minto
19. S. Santiam Hatchery
20. Willamette River Hatchery
21. Sandy Hatchery
22. Eagle Creek Hatchery
23. Skamania Hatchery
24. Washougal Hatchery
25. Bonneville Dam
26. Bonneville Salmon Hatchery
27. Cascade Hatchery
28. Carson Hatchery
29. Little White Salmon Hatchery
30. Willard Hatchery
31. Spring Creek Hatchery
32. Big White Rearing Pond
33. Klickitat Hatchery
34. Oak Springs Hatchery
35. Round Butte Hatchery
36. John Day Dam
37. McNary Dam
38. Columbia River @ Pasco
39. Ringold Hatchery
40. Priest Rapids Spawning Channel
41. Leavenworth Hatchery
42. Rocky Reach Spawning channel
43. Entiat Hatchery
44. Wells Salmon Pond
45. Winthrop Hatchery
46. Ice Harbor Dam
47. Little Goose Dam
48. Lower Granite Dam
49. Clarkston, Wa.
50. Grande Ronde River
51. Wallowa Hatchery
52. Dworsbak Hatchery
53. Kooskia Hatchery
54. Riggins, Idaho
55. Rapid River Hatchery
56. S. tork Salmon River
57. Lochsa River
58. Pahsimeroi
59. Hayden Creek Pond, Lemhi R.
60. Lower Kalama
61. McKenzie @ Leaburg
62. Shears Falls, Deschutes R.
63. Warm Springs River
64. Stayton Pond, Willamette R.
65. Oak Ridge NFH
66. Weyco Pond, Grays R.
67. Chelan
68. Asotin, @ Snake River
69. Upper Salmon, Decker Flats

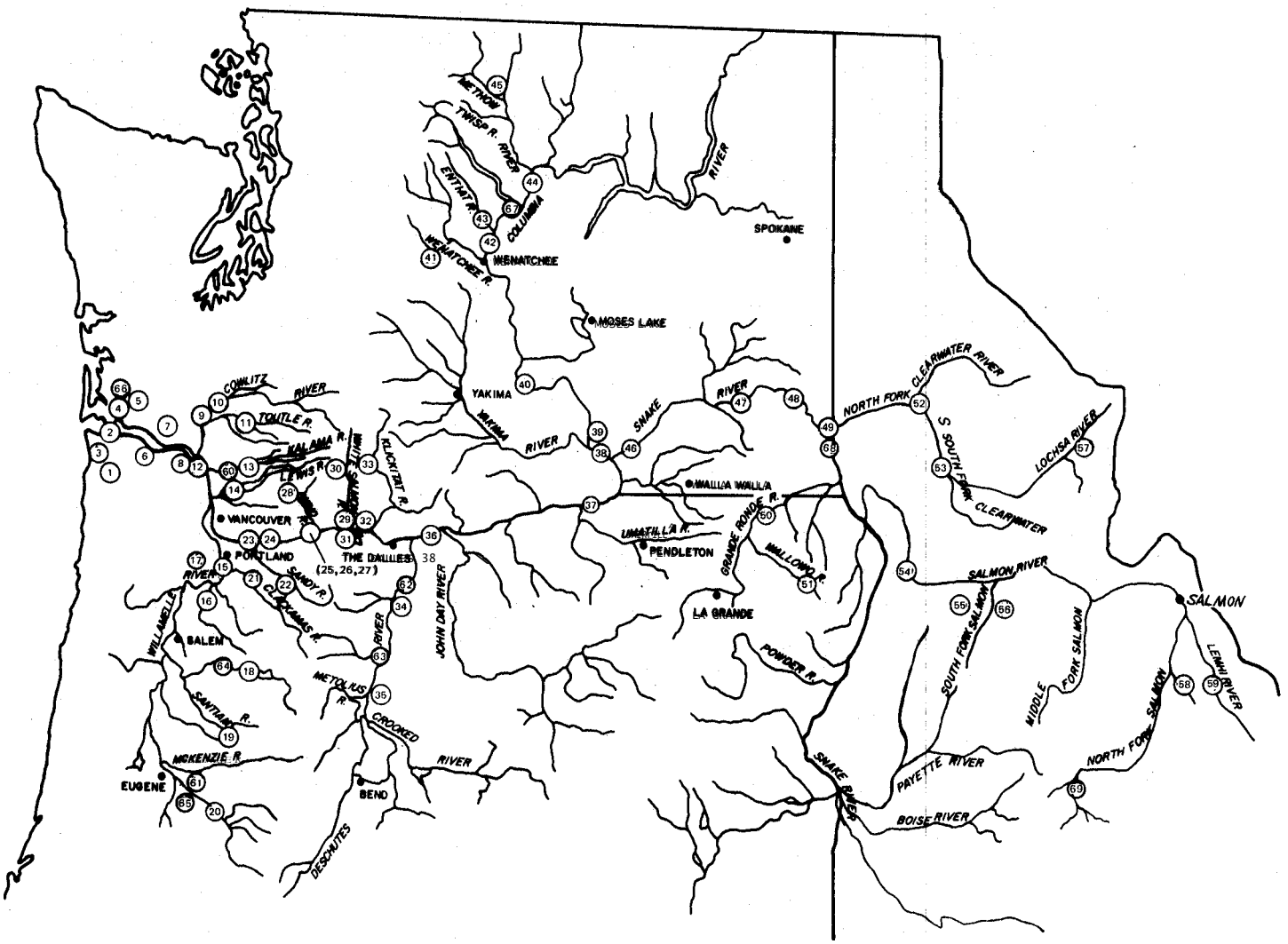

Figure 2.-Release locations of marked juvenile salmonids recaptured in the Columbia River estuary, 1979.

releases were used to define stock composition of the migrant population, to provide sampling efficiencies, and to define migrational. timing and rates of downstream movement. Recoveries of replicate tag groups (same release site, date, stock, and size of fish) from several hatcheries were compared using a "C" statistic test to detect inconsistency in estuarine sampling.

Two types of survival estimates were also made using recovery data at Jones Beach. Estimates of relative survival were determined from recovery ratios of fish groups subjected to dissimilar treatments. Control groups of fall chinook salmon from Spring Creek, Little White Salmon, Bonneville, Washougal, and Klickitat Hatcheries were branded and released at Rainier (RKm 109) or Prescott (RKm 115), Oregon. Jones Beach catch rates of these control releases were compared to catch rates for tagged groups from the same fish stocks released at the hatchery to determine percent survival.

The marking program to determine relative survival was accomplished with extensive assistance of: Steven Leek, Elmo Barney and his staff, Jack Bodle and his staff at USFWS, William Hopley, Carl Ross and his staff, Richard Johnson and his staff at Washington Department of Fisheries (WDF), George Smalley and Vernon Knowles and his staff at ODFW, and Robert Vreeland (NMFS) and others involved with the "Columbia River Fall Chinook Evaluation".

Water Temperature Sampling

Surface water temperatures at Jones Beach were taken.. with a hand-held thermometer on all days on. which sampling was conducted.

RESULTS AND DISCUSSION

Water temperature in January and early February 1979 (0° to 2°C) was considerably colder than normal and remained cold in March (4° to 7°C), (Figure 3). River flow during the spring freshet was about average- in

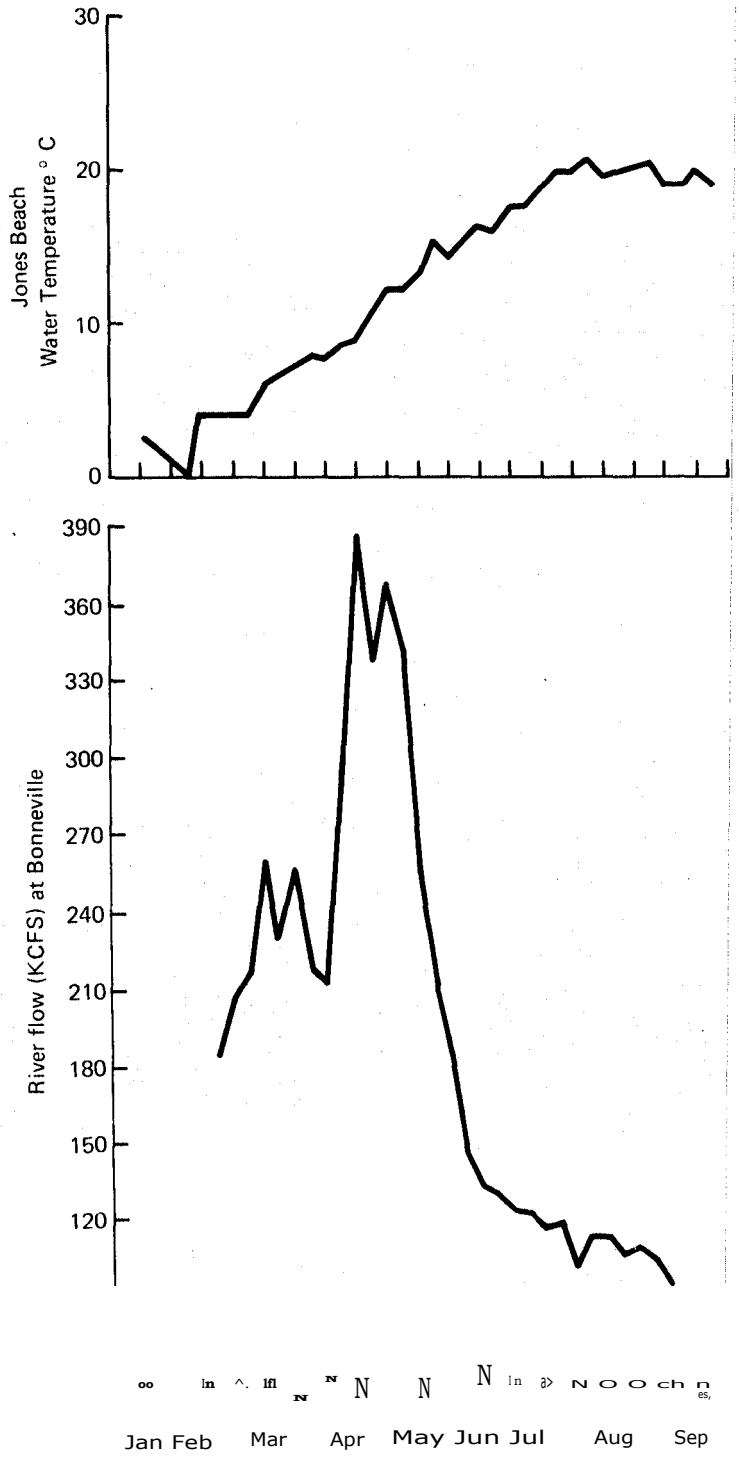

Figure 3.--Water flow and temperature in the Columbia River, 1979.

1979. Flows were about 400 kcfs in early May, but declined slightly earlier than normal in mid-June to 200 kcfs and to 140 kcfs by 1 July.

Sampling at all fishing sites from January through September 1979 (2004 sets) provided a total sample of 288,057 subyearling chinook salmon; 25,893 yearling chinook salmon; 35,190 coho salmon; and 11,041 steelhead. Species catches and sampling effort at the different sampling sites varied throughout the sampling season; weekly summaries are included in Tables 1-4. Recapture rates of marked fish groups ranged from 0 to 1.3% (Appendix Table 2). In total, 15,381 cwt and 4,821 external marks (5.6% of the total catch) were recovered (Table 5). The cwt retention of smolts, as determined by the total number of cwt recovered compared to the total number of fish with clipped adipose fins, averaged 93%. This was similar to cwt retention in 1977 and 1978. Steelhead had the lowest retention rate (84%), whereas subyearling chinook salmon had the highest (94%).

Multiple recapture of fish sampled at Jones Beach was 0.93% for subyearling chinook and 0.00% for other salmonids. Adjustment of recapture data for multiple recapture was not made.

Migrational Timing

The timing of outmigration, based on temporal catch distributions at Jones Beach, varied between subyearling chinook, yearling chinook, and coho salmon, and steelhead (Figure 4). The timing was affected by a combination of hatchery release times and river flows. River flows affected the efficiency of fish recapture. With lower flows, gear efficiency was greater, thus timing Peaks were weighted toward low flow periods. Although the magnitude of flow changes throughout a given outmigration, the rate of change each year remains fairly constant in average flow years. Thus large differences in timing between years appeared mostly related to hatchery releases.

Table 5.--Recoveries of marked juvenile salmonids from the Columbia River estuary, 1979.

Species	Number recovered				
	Coded wire tags (cwt)	Adipose fin clip (no cwt)	Brands	Fin clips	Total
Chinook salmon - subyearlings	9980	618	2486	97	13181
Chinook salmon - yearlings	2824	228	1244	50	4346
Coho salmon	2069	151	463	1396	4079
Sockeye salmon	1	0	24	0	25
Steelhead trout	507	79	560	501	1647
Totals	15381	1076	4777	2044	23278

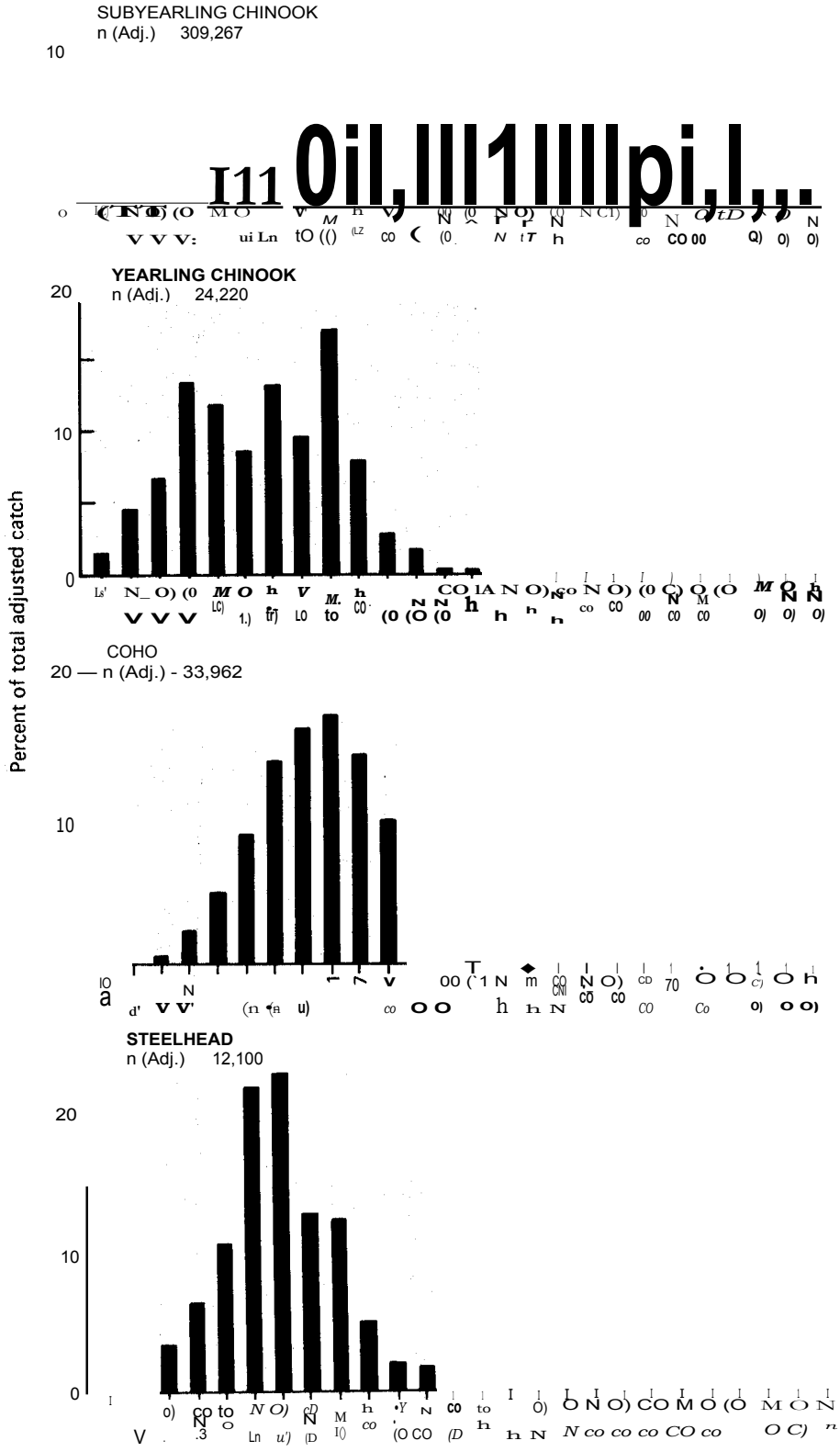

Figure 4.••-Tem[P]oral catch distribution of subyearli.nn chinook salmon ca[p]tured usin(T beach seine, and veirl.inry chinook and coho salmon and steelhead outmirants using nurse seine at Jones Beach, OR, 1979.

Migrational timing for subyearling chinook salmon in 1979 showed several peaks of migration between early May and late July (Figure 5). During March and April we captured a substantial number of subyearling chinook salmon averaging 45 mm in length, many more than in past years. We assumed that most of these fish were not smolting and resulted from thinning releases of spring chinook salmon at lower river hatcheries (Foster) [4]/.

The period of maximum fish passage for subyearling chinook salmon in 1979 was in mid-July as compared to mid-June in 1978 and mid-May 1977 (Figure 5). Periods of maximum fish passage were related to hatchery releases. In 1977, 30 million fish were released from Bonneville Hatchery on 5 May. In 1978, Bonneville released 16 million fish in mid-May and at the same time Little White Salmon Hatchery released 11 trillion fish. In 1979, Bonneville released 11 million fish in late May and Little White Salmon Hatchery released 11 million fish in late June.

Yearling chinook salmon first arrived in the estuary in mid-February, the migration peaked in mid-April, receded, then peaked, again on 1 June (Figure 4). The first peak was related to fish released from hatcheries below the Dalles Dam (excluding Eagle Creek Hatchery), whereas the second peak resulted from hatchery and wild stocks from the Snake River and mid-Columbia River.

Coho salmon migrated by Jones Beach from mid-April to late July producing a later than normal peak near 1 June (Figure 4). This shift in timing (usually peaking in mid-May) was related to hatchery releases made in June and July which had been purposely delayed to examine effects of later release date on adult returns.

4/ Robert Foster, Washington Department of Fisheries, Fish Culture Division, Olympia, WA 98504, personal communication, Jul 1980.

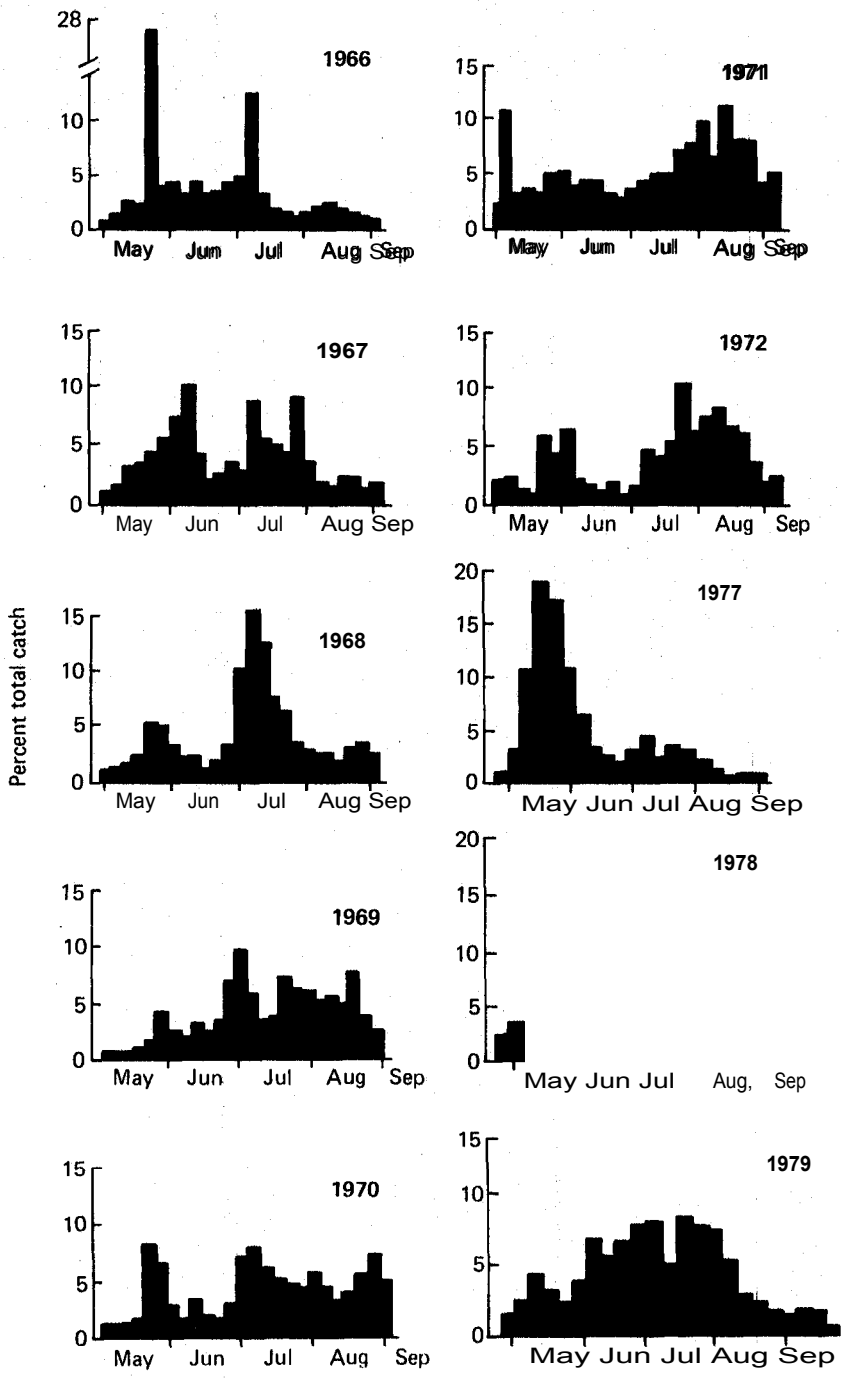

Figure 5.--Temporal catch distribution of subyearling chinook salmon at Jones Beach, OR, 1966-1972 and 1977-1979.

Steelhead migrated by Jones Beach between late April and late June with a peak in mid-May (Figure 4). This appeared to be consistent with past years.

Travel Time and Rates of Movement

Individuals from several groups of marked chinook salmon, released in 1978, were observed to over-winter prior to migrating to the ocean. Recaptures of 119 juveniles from 29 different groups (Table 6) were made at Jones Beach and RKm 16. The majority of these fish were from fall releases made in the Willamette River system. Only a few were recaptured from spring and summer releases at other sites.

Rates of migration varied dramatically between groups depending upon specie, age, release site, and date of release (Appendix Tables 3-5). For subyearling chinook salmon, higher rates of migration from release site to Jones Beach were positively correlated with: 1) increased fish size (Dawley, et al.),s/ 2) increased distances of migration from release sites, and 3) higher river volume (Sims)6. Similartrends were not apparent with any of the yearling migrants.

Average movement rates from release site to the estuary and through the estuary into the ocean, were generally the same as those observed in 1978 (Table 7). Subyearling and yearling chinook slalmon apparently

S/ Dawley, E.M., C.W. Sims, R.D. Ledgerwood, D.R. Miller, and F.P. Thrower. 1979. A Study to define the migrational. characteristics of chinook and coho salmon and steelhead in the Columbia River estuary. Annual Report to PNRC, by NMFS, 2725 Montlake Blvd. E., Seattle, WA 98112.

6'Carl Sims. National Marine Fisheries Service, Cbastal Zone and Estuarine Studies Division, 2725 Montlake Blvd. E., Sealttle, WA 98112, unpublished report, July 1977.

Table 6.--Chinook salmon recaptured in 1979 from groups released in 1978.

Release information					Individuals recaptured by month						
Tag no. a/ (Ag, D1, D2)	Site	Date mo/day		Size no./lb	1979 J	F	M	A	M	J	Total no. recap
63-16-63	Klickitat Hatchery	6	JN	87	0	0	0	0	0	1	2 b
63-17-49	Priest Rapids	26	JN	45	0	0	1	0	0	0	1
63-18-03	Washougal Hatchery	26	JN	62	0	0	0	3	2	0	5
63-17-46	Kalama Falls Hatchery	12	JL	108	0	0	0	2	0	0	2
63-17-47	Kalama Falls Hatchery	15	SE.	34.	0	0	0	8	0	0	8
10-03-28	Red River at SF Clearwater	21	SE	6	0	0	0	0	5	1	6
07-16-54	Deschutes River	3	OC	13	0	0	0	1	1	0	2
07-16-55	Deschutes River	3	OC	13	0	0	0	1	1	0	2
07-16-56	Bonneville Hatchery	30	OC	12	0	0	1	4	1	0	6
07-16-58	Bonneville Hatchery	30	OC	20..	0	1	0	3	0	0	4
07-16-59	Bonneville Hatchery	30	OC	14	0	0	2	2	0	0	4
07-16-60	Bonneville Hatchery	30	OC	24	0	1	0	3	2	0	6
05-03-52	Little White NFH	1	NO	34	0	0	1	1	0	0	2
05-03-53	Little White NFH	1	NO	34	0	0	0	1	0	0	1
05-03-54	Little White NFH	1	NO	34	0	1	0	0	0	0	1
07-17-27	N Santiam at Minto	6	NO	10	0	0	1	5	4	0	10
07-17-28	N Santiam at Minto	6	NO	8	0	0	0	3	4	1	8
07-17-38	M Fork Willamette	6	NO	8	0	0	1	0	0	0	1
07-17-37	M Fork Willamette	7	NO	9	0	0	1	1	0	0	2
07-17-39	M Fork Willamette	7	NO	14	0	0	1	1	0	0	2
07-19-26	S Santiam at Foster	7.	NO	8	0	1	1	1	0	0	3
07-19-27	S Santiam at Foster	7	NO	8	0	0	0	0	1	0	1,
07-19-28	S Santiam at Foster	7	NO.	7	0	0	1	0	0	0	1
07-19-29	Willamette R Below Falls	7	NO.	8	0	0	0	3	0	0	3
07-19-30	Willamette R Below Falls	7	NO	7.	0	0	0	7	0	0	7
07-16-26	Mill Creek	8	NO	23	0	0.	4	3	2	0	9
07-17-40	M Fork Willamette	8	NO	26	0	0	0	1	1	0	2
07-19-17	Mill Creek	9	NO	22	0	0	3	6	1	0	10
07-19-18	Mill Creek	9	NO	23				2	5	0	9
				Total		4	20	62	30	3	119

a/ Binary cwt, where: Ag=Agency, Dl=data 1, and D2=data 2 codes.
b/ Second recapture in September 1979.

Table 7.--Migration rate for selected groups of marked juvenil salmon and steelhead,(1978-1979).

	Chinook							
	Subyearling		Yearling		Coho		Steelhead	
	1978	1979	1978	1979	1978	1979	1978	1979
Release site to RKm75[11]								
Average (km/day)	15	18	21	23	14	111	22	34
Range (km/day)	3-27	2-48	2-37	6-37	6-19	10-141	8-35	10-61
No. mark groups	11	11	11	11	3	3	4	4
P%Km 75 toRKm 16[b/]								
Average (km/day)	4	3	15	15	26	221	44	
Range (km/day)	2-63	1-58	8-63	6-58	16-63	12-571	31-63	
No. mark groups	14	9	8	5	4	3	3	0
RKm 16 to Ocean (24-km radius of Col. R.)-[c)]								
Average (km/day)	2	4	<1	1	-	13I		
Range (km/day)	1-63	4-37	-	<1-10				
No. mark groups	19	31	1	9			-	0

a/ 1979 recaptures are paired to similar groups released in 978 but are not representative of the entire run. Data from 1979 are listed 4ri Appendix table 3.

b/ All groups recaptured in substantial numbers were averaged for each year. Data from 1979 are listed in Appendix table 4.

c/ All groups recaptured in the Ocean were used for these avrages. Data from 1979 are listed in Appendix table 5.

decreased their rate of movement in the estuary. They traveled at an average rate of 18 to 23 km/day, respectively, from site of release to Jones Beach versus 3 and 15 km/day between Jones Beach (RKm 75) and RKm 16. At least part of this decrease can be attributed to incoming tidal currents in the estuary. Coho salmon and steelhead appeared to migrate more rapidly than chinook salmon after entering the upper estuary.

Migration rates and timing from RKm .16 to the ocean were not very precise due to an unknown time of ocean residency prior to capture. Individuals were caught in as few as 10 days and migrated as fast as 35 km/day from release site to the ocean. Spring chinook salmon from groups released 27-30 March At Klickitat Hatchery passed RKm 16 on 26 April (median date) and were recaptured in the ocean during mid-May, late JuneL/, and mid-August.

Diel Catch Patterns

Purse seine catches of subyearling Chinook salmon in mid-river peaked about 2 hours after sunrise, then decreased throughout the day and night (Figure 6). Beach seine catches in 1978 were bimodal. Catch peaks occurred just after sunrise and just before sunset, followed by a dramatic decrease at night. Sims6/ noted similar diel. beach seine catch patterns in the estuary and found that tidal cycle had little effect on this catch pattern.

7/ Recaptures in June were made by Oregon State University researchers. (Pearcy, 1979) OSU, Dept. of Biology, Corvallis, OR.

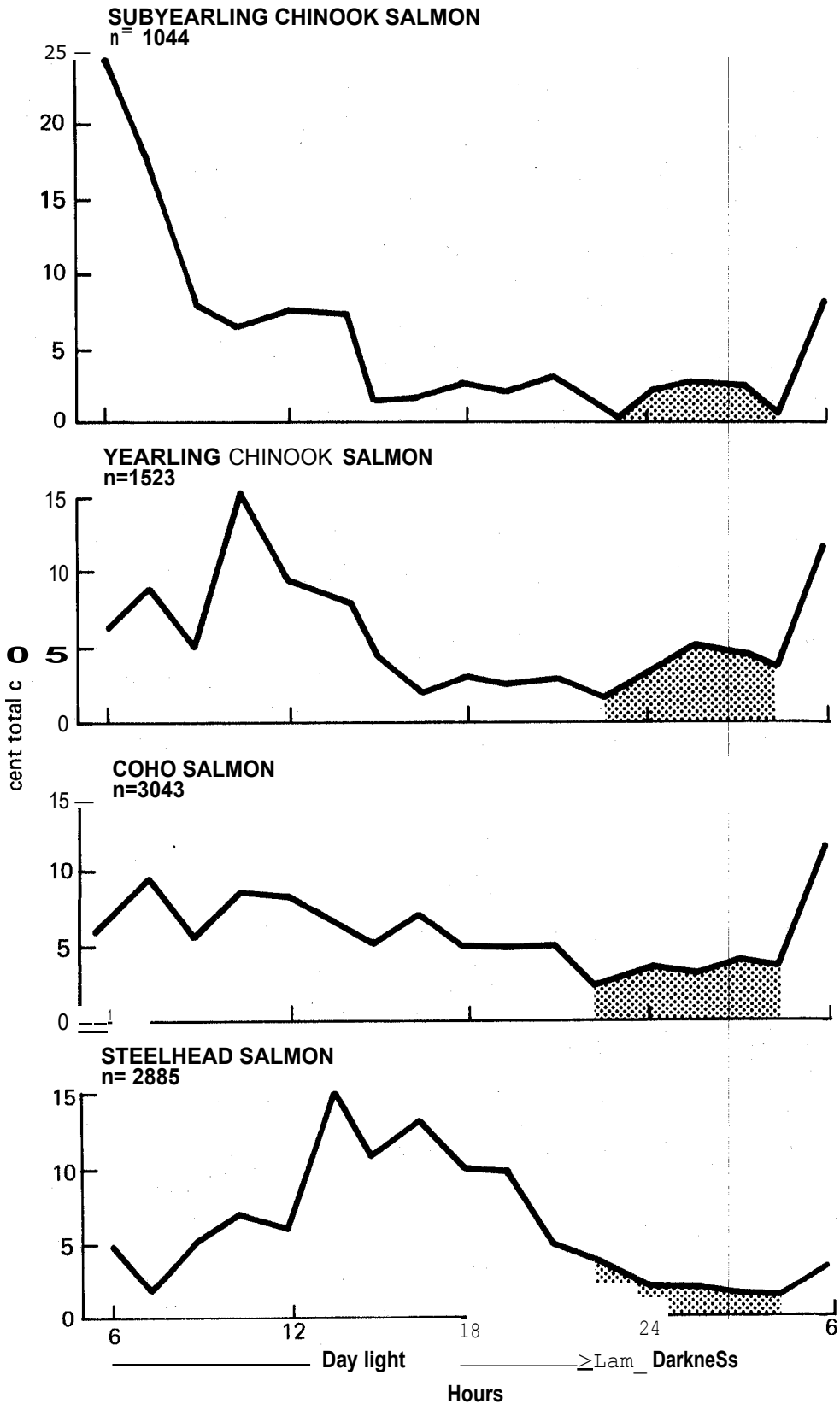

Figure 6.--Average diel catch pattern for chinook salmdn, coho salmon, and steelhead from purse seining at Jones Beach, OR, 1979.

Spring chinook. salmon catches showed a high degree of variability between the two sampling. dates, although the total number of fish caught was similar..Sampling in early May showed little change in catch rates throughout. the 24-hour period. Sampling in late may,. however, showed little change in catch rates throughout the 24-hour period. Sampling in late May, however, showed a very..distinct peak near midday followed by a sharp decrease in the afternoon and a slight increase. at night. (average of the two sampling periods presented in Figure .6).

Purse seine catches of coho salmon were highest during the. day and decreased somewhat at night (Figure 6), with no mid-afternoon peak, as observed in 1978 beach seine catches.

Steelhead catches. on both sampling days, -although markedly different in total catch, produced similar diel patterns. Catches peaked around mid-day and decreased substantially at. night (Figure 6).

Size Characteristics of Juvenile Migrants

Mean fork lengths ranged from 45 mm for subyearling chinook salmon to 230 mm for steelhead in 1979 (Figure 7). Subyearling chinook salmon averaged 45 mm in February and March and probably were nonsmolting fish. Smolts began arriving at Jones Beach in early April at nearly 70 mm and steadily increased in size, leveling off at about 85 mm in August and September; 20 mm less than the same time period in 1978.

Several mark groups of subyearling chinook salmon exhibited increases in mean fork length between the dates of release and recapture at Jones Beach. Five weeks after release, individuals from Kalama Falls Hatchery were consistently larger than their mean length at release. Six weeks after release, the fork lengths of some individuals were greater than the largest fish measured at the date of release.

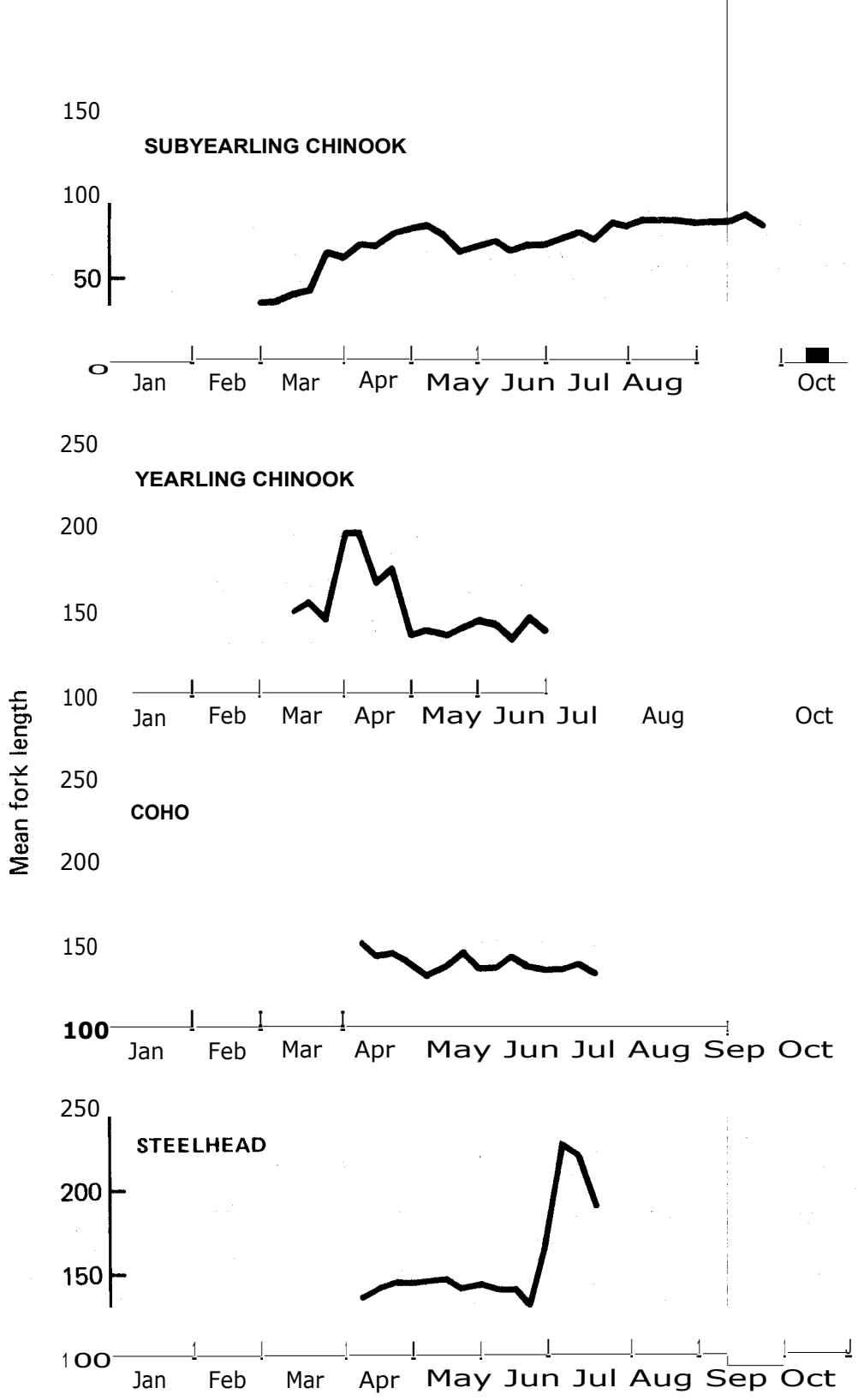

Figure 7.--Mean fork lengths of chinook salmon, coho salmon, and steelhead Juveniles at Jones Beach, Or., 1979.

Yearling smolts were fairly consistent in size throughout the migration period, with a few fluctuations representing particular stocks. Overall mean lengths were 153 mm for yearling chinook salmon, 139,mm for coho salmon, and 157 mm for steelhead.

Survival of Marked Fish Groups

Survival estimates to the estuary. are' dependent upon consistency of recapture. To evaluate consistency of sampling at Jones Beach, catches were compared for all replicate groups released, from various sites in the Columbia River basin from 1977 to 1979. Statistical analysis using the "G" test detected no significant difference in 80 of. the 91 possible comparisons (Figure 8). When adult return, data from hatcheries and sport and commercial fisheries have been obtained, it may be possible to relate differences in adult returns to differences in smolt survival to the estuary.

Relative Survival

Relative survival estimates for chinook salmon and steelhead groups which were transported past dams, and for coho salmon groups released in June and July have been made.

The survival increase for various transported groups ranged from 20 to 1532% (Table 8). The group showing a 1532% increase over control was subyearling chinook salmon reared at Hagerman NFH and transported to Bonneville, compared to a group released into the Snake River at Asotin, Washington. The lowest increase in survival measured (20%) was for yearling chinook salmon transported to Bonneville compared to a similar group released in the Deschutes River. There was no measurable increase in survival for a similar comparison of Deschutes fish released in 1978.

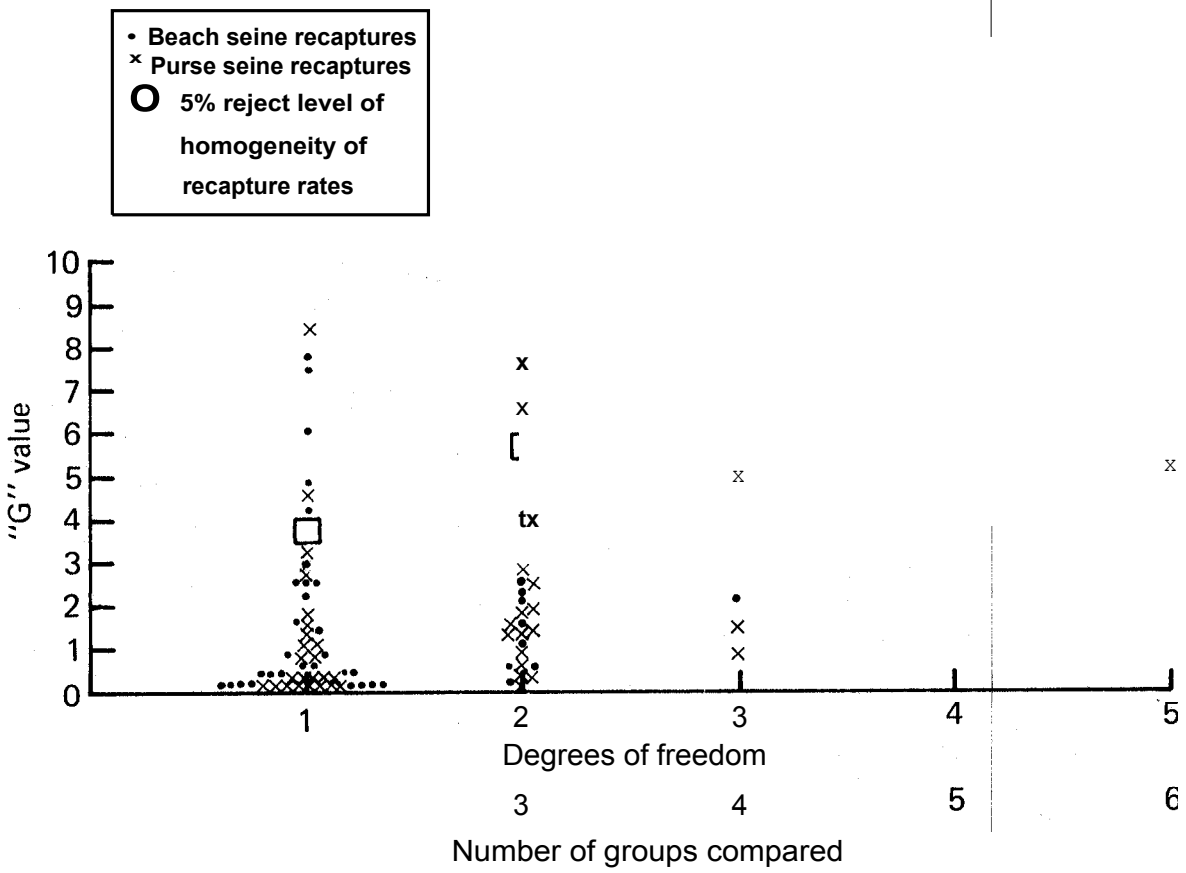

Figure 8.--"G" statistic evaluation of recapture rates for replicate mark groups of juvenile salmonids captured at Jones Beach, OR, using beach and purse seine, 1977--1979.

Table 8.--Survival increase for transported vs control fish groups recaptured at Jones Beach, Oregon November 1978 September 1979.

Mark a/ (Ag/Dl/D2)	Release site	Release date	Size (no./ib)	Recapture percentage adjusted b/ Beach seine	Purse seine	Beach & purse	Avg survival increase from transport (%)
		Subpearling chinook salmon					
05-04-21	Asotin (Hagerman)	21My	92	0.00	0.01	0.01	
05-04-20	trans below Bonn dam	.20My	84	0.13	0.05	0.18	1532
		Yearling chinook salmon					
07-19-26	S. Santiam	07No78	8	0.00	0.00	0.01 d/	
07-19-27		07No78	8	0.00	0.00		
07-19-28		07No78		0.00	0.01)		
07-19-29	trans below Will fa11	08No78	8	0.01	0.01)		
07-19-30		08No78		0.01	0.0	0.03—	262
05-04-26	Kooskia	29Ap	40	0.00	0.05	-0.05	
05-04-27	trans below Bonn dam	03-29My	44	0.04	0.06	0.10	102
07-19-19	S. Santiam Hat.	21Mr	9	0.02	0.10		
07-19-20	" "	21Mr	8	0.02	0.15	0.17	
07-19-21	"	21Mr	9	0.04	0.17		
37-19-22	trans below Will fa11	23Mr	9	0.14	0.09		
07-19-23	" "	23Mr	10	0.16	0.15	0.26	60
07-19-24	" "	23Mr	8	0.11	0.13		
07-18-25	Deschutes R. (km 161)	3OMy	22	0.00	0.24		
07-18-26		23My	25	0.00	0.3	0.28	
07-18-27	trans below Bonn dam	30My	22	0.03	0.31	0.34	20
63-18-10	Leavenworth Hat..	26Ap	16	0.00	0.121		
63-18-09		26Ap	16	0.00	0.14J	0.13	
63-18-08	trans below Priest Rapids dam	15My	16	0.00	0.21	0.21	63

Table 8.-cont

Mark[a] (Ag/D1/D2)	Release site	Release date	Size (no./lb)	Recapture percentage adjusted[b] Beach seine	Purse seine	Beach & Purse	Avg survival increase from transport[c] (%)
			Yearling chinook salmon				
63/18/11	Winthrop Hat.	20Ap	12	0.00	0.05)	0.04	
12	" "	24Ap	14	0.00	0.03		
20	trans below Priest Rapid	16My	13	0.00	0.11	0.11	150
			Steelhead				
10/05/33 and RA SU 2	Dworshak Hat.	18My	12	0.00	0.11	0.04	
10/05/34	trans below Bonn dam	14My	12	0.00	0.17	0.17	148

a/ Binary cwt, where: Ag=Agency, Dl=data 1, and D2-data 2 codes. RASU 2 is a freeze brand.

b/Adjusted for standard effect (10 sets/day beach seine and 5 sets/day purse seine--7 days/week) and 100% identificatior

- -rrf--cwt-,---

c/ $\frac{(C/)}{(\Gamma\%)C\%}$ x 100

d/ Due to decreased sampling in the winter months actual number of recaptures were used.

Series of coho salmon releases from 'Washougal, Toutle, and Cascade Hatcheries were made to evaluate the effect of release date on survival. Recapture rates at Jones Beach were dramatically different between the May, June, and July releases (Table 9). A consistent increase in survival with time was apparent. Some of this apparent increase was no doubt a consequence of decreased river flow (250 to 175 to '125 kcfs over the recapture period) which increased the recapture efficiency. However, it is unlikely that the 50% lower river flow would have accounted for the increased catch rate of 545% (averaged for the three hatcheries).

Relative survival estimates (obtained by comparing recapture rates at Jones Beach, Appendix Table 2) for groups subjected' to various other treatments (diet, rearing density, release timing, and release site) are left to the fish culturist for interpretation.

Absolute Survival

Absolute survival. estimates for index groups of wiretagged and branded subyearling chinook from Spring Creek, Little White Salmon, Bonneville, Klickitat, and Washougal Hatcheries ranged from 19 to 62% (Table 10). These values were similar to measurements .made at Jones Beach in previous years.

Incidental Catch

Large numbers of fish of non-target species were caught along with juvenile salmonids at the various sampling sites (Appendix Tables 6-9).

two species caught in greatest numbers at Jones Beach were the three-spined stickleback and juvenile shad (Appendix Table 6 and 7). Stickleback catches were the same as 1977 but only one-third of 1978. Shad catches were 36% greater than 1977 and 167% greater than 1978. Incidental

Table R.--Movement and recapture rates for groups of serially released coho salmon recaptured at Jones Beach, Oregon, 1980.

Mark [a/] (Ag/Dl/D2)	Release site	Size (no./lb)	Release date	Recap. date of med. fish	Rate of movement (km/day)	Recapture rate Actual (no.)	Recapture rate Adjusted (%)
07-19-08	Bonneville (cascade Hat.)	23	07My	18My	14	13	0.06
07-19-11		22	07My	20My	12	10	0.04
07-19-07		23	07Jn	13Jn	26	35	0.13
07-19-10		23	07Jn	13Jn	26	32	0.12
07-19-09		22	0631	1331	22	50	0.36
07-19-12		23	0631	13J1	22	54	0.41
63-19-11	Toutle Hat.	18	07My	20My	9	47	0.11
63-19-12		18	07My	19My	7	41	0.12
63-19-13		20	07Jn	13Jn	14	114	0.28
63-17-58		18	07Jn	12Jn	17	121	0.31
63-19-28		18	0631	1331	12	217	0.54
63-19-29		18	0631	13J1	12	201	0.49
63-19-23	Washougal Hat.	17	07My	21My	10	72	0.13
63-19-24		16	07My	21My	10	69	0.11
63-19-25		20	07Jn	17Jn	15	111	0.17
63-19-26		20	07Jn	14Jn	21	107	0.15
63-19-'27		20	0631	13.11	21	183	0.49
63-19-34		20	0631	1331	21	187	0.49

a/ Binary cwt where: Ag=Agency, D1-data 1, and D2=data 2 codes.

b/ Adjusted for standard effort (10 sets/day beach seine and 5 sets/day purse seine--7 days/week) and 100% identification of cwt.

Table 101--Absolute survival of fall (subyearling) chinook salmon from hatchery release site to the upper estuary (RKm 115) as measured by recaptures at Jones Beach, Oregon, 1979:

Mark[a/] (Ag/D1/D2) or brand (Loc. rot.)	Release site	Distance upriver (km)	Date	Size (no./lb)	Recaptures adjusted (no.)	%	Survival %
05-04-46	.Spring Cr. H.	267	20Mr	125	211	0.15	19
RD U 1	Prescott	115	03Ap		122	0.81	
05-04-34	Spring Cr. H.	267	20Ap	87	179	0.24	30
05-04-44	Spring Cr. H.	267	2OAp	78	229	0.21	34
RD U 2	Rainier	109	02My	83	51.	0.26	
05-04-33	Spring Cr. H.	267	18My	50	25	0.02	16
RD U 4	Rainier	109	29My	52	28	0.13	
05-04-48	Little White H.	261	22Jn	105	159	0.12	38
05-04-49	Little White H.	261	22Jn	123	293	0.15	47
LD U 3	Rainier	109	26Jn	114	64	0.32	
07-16-08	Bonneville H.	230	OlMy	78	113	0.15	50
RD U 3	Prescott	115	16My	64	52	0.30	
63-19-49	Klickitat H.						
LD U 1	Rainier						
63-19-38	Washougal H.	221	143n	95	268	0.32	50
63-19-46	Washougal H.	221	14Jn	95	521	0.40	62
LD U 2	Rainier	109	25Jn	74	136	0.65	

a/ Binary cwt, where: Ag=agency, D1=data and D2=data 2 codes.

catches at the RKm 16 site involved many marine and euryhaline species as well as freshwater species (Appendix Table 8). Incidental catches at marine sites involved 30 species (Appendix Table 10). Catches in the lower estuary and ocean were not comparable between years due to variation in effort at differing tidal stages and dates.

SUMMARY AND CONCLUSIONS

1. Beach and purse seines in the upper estuary (RKm 75) and purse seines in the lower estuary (RKm 16) and Pacific Ocean near the Columbia River mouth were used to monitor smolt outmigration in 1979.

2. Catches of smolts in 1979 were slightly greater than in 1978.

3. By request, various biological samples were collected from adipose clipped fish for other researchers.

4. The period of maximum subyearling chinook salmon migration in 1979, based on Jones Beach recaptures, was in mid-July as compared to mid-May in 1977 and mid-June in 1978. The differences were related to hatchery releases and changes in catch efficiencies due to river flow.

5. Movement rate of chinook salmon decreased upon entry into the estuary. Residency in the Columbia River plume precluded precise measurements of movement rate into the ocean. Steelhead and coho salmon generally moved rapidly through the estuary and were not recaptured in the ocean.

6. Diel catch patterns at Jones Beach show a decrease at night for subyearling chinook and coho salmon, and steelhead. Patterns for yearling chinook salmon were inconclusive.

7. No significant differences were detected in recapture rates in 80 of 91 possible comparisons between replicate groups. Th41s recapture rates generally could be compared between unlike groups, from the same stock, to obtain relative survival measurements.

8. **Fish** groups **transported downstream past** dams in the Columbia River basin showed relative increases of 20 to 1500% survival as compared non-transported fish.

9. Coho salmon:: groups released in June and July showed a consistently higher relative survival rate.than **groups' released** in **May**.

10.. Measurements of **absolute survival** for fall **(subyearling)** chinook salmon, from release site to the estuary, ranged from 19 to 62% for index stocks.

11. Adult returns in future years should provide infmrmation as to the precision of juvenile survival estimates to the estuary as a predictor of ..adult return rates.

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